Putting the spray onto the target – the development and demonstration of a vineyard patternator for growers to reduce their spray bill by 30%

A report to NY IPM

December 2006

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Finger Lakes grape team: Tim Martinson
Lake Erie grape team: Hans Walter-Petersen, Andy Muza (Penn State)
Long Island team: Rebecca Wiseman, Sustainable Ag Program

Abstract

Many airblast sprayers send a plume of spray over the trees, resulting in off-target drift, inadequate deposition and poor insect/disease control. Results from tests over the past three years with an Italian vertical patternator, the MIBO, shows growers that they can adjust their sprayers to target the canopy. In the Spring of 2006 we designed, developed and constructed two inexpensive patternators of different designs, and in the summer of 2006 we evaluated them against the "standard" MIBO patternator. We demonstrated the two designs at fruit grower meetings in the Hudson Valley, the Finger Lakes, Lake Erie region and on Long Island and subsequently improved the design. The plans are available for growers and a number have already been built

Background

The MIBO vertical patternator comprises a vertical mast which travels through the spray cloud. Droplets are intercepted by a collection device, the resultant liquid then passes through pipes to graduated collection tubes. The collected liquid shows a pattern, it shows how the spray is distributed within the tree, and how much spray goes over the top of the canopy as drift. The sprayer operator can adjust nozzle orientation to improve deposition on the target e.g to the fruit zone rather than wasting spray over the canopy. The MIBO patternator, developed at the University of Turin costs $4000, plus shipping and import costs.

Objectives

1. Design, develop and evaluate two different, inexpensive, vertical patternators which growers can construct at their farm workshop.
2. Demonstrate the patternator designs across apple growing regions of New York
3. Increase the efficiency of application by improving the technical condition of sprayers
4. Reduce pesticide application costs for growers by correct targeting
5. Decrease environmental pollution
6. Improve growers knowledge of application technology & sprayer management via extension demonstrations

Procedure

From August 2005 until August 2006 a visiting professor, Dr Emilio Gil, Universitat Politécnica de Catalunya (UPC), Dept. Agri Food Engineering and Biotechnology, Barcelona, Spain was working in my application technology group. We decided in the Spring of 2006 to design one patternator each and see how well they performed. They were called the UPC patternator (Gil design) and the Cornell patternator (Landers design).

The UPC (Gil) design

Ten 6" PVC elbows were mounted in plastic frames attached to a 1.5" angle steel frame. Each elbow faced outwards and at the other end a plastic funnel was attached. A plastic hose connected the funnel to a box containing graduated measuring cylinders. The spray cloud entered the open end of the elbows, passed into the funnels and then ran down to the collection cylinders. A 9 feet tall version was constructed and this was very robust but quite heavy. It was decided that a taller version would be too difficult to erect due to the weight. The frame was constructed in two halves for ease of assembly. Appendix A shows the build list and plans for the patternator issued at the grower meetings.

Figure 1 The UPC patternator.

The Cornell patternator (Landers) design

Nine 14” x 48” wide fly screens were connected via hooks to two 14 foot high, 4”x2” wooden boards. A small gutter was attached, at an angle, to the bottom edge of each screen. The gutter sloped to one end where a plastic hose was connected which ran down to a box containing graduated measuring cylinders. The spray cloud hit the fly screen, the air passing through and the liquid ran down the front of the screen, into the gutter and then, via the plastic hose into the collecting cylinders. The frame was constructed in two halves for ease of assembly. Appendix B shows the build list and plans for the patternator issued at the growers meetings.

Figure 2 The Cornell Patternator

Results and discussion

Comparison of three vertical patternators with four sprayers

A series of experiments were conducted to test the UPC and Cornell patternators to see if the new designs would be as accurate as the "standard" MIBO. Four sprayers were tested, a Berthoud S600EX airblast sprayer, a CIMA directed deposition sprayer with tower, a Hardi Mercury airblast sprayer and a Turbomist with a tower. All sprayers were equipped to spray 50 gallons per acre and 3 repetitions were carried out for each trial.

Spray recovery

An experiment was conducted to measure the amount recovered by each of the patternators compared to the output of each of the sprayers. Figure 3 and Table 1 shows that the Cornell patternator captured the most, averaging 68% of the applied spray. The highest amount recovered was with the Berthoud sprayer when 87.7 % was recovered.

	UPC	**CORNELL**	**MIBO**
Recovery %	22.1	67.8	19.8

Table 1. Average percent recovered by 3 patternators

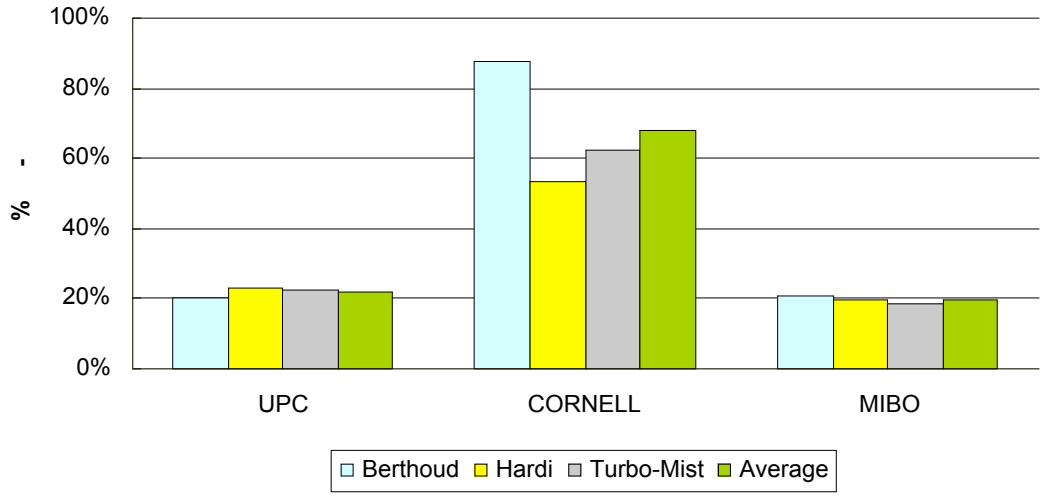


Figure 3 Percent recovery

Symmetry

A second experiment was conducted to compare the symmetry recorded by each patternator. Good symmetry would be in the region of 90-95% of a sprayer output pattern occurring on both the left and right hand side of the sprayer. The results in Figure 4 shows that the MIBO patternator gave the best indication of symmetry, with the UPC and Cornell patternators being similar in their ability to measure symmetry.

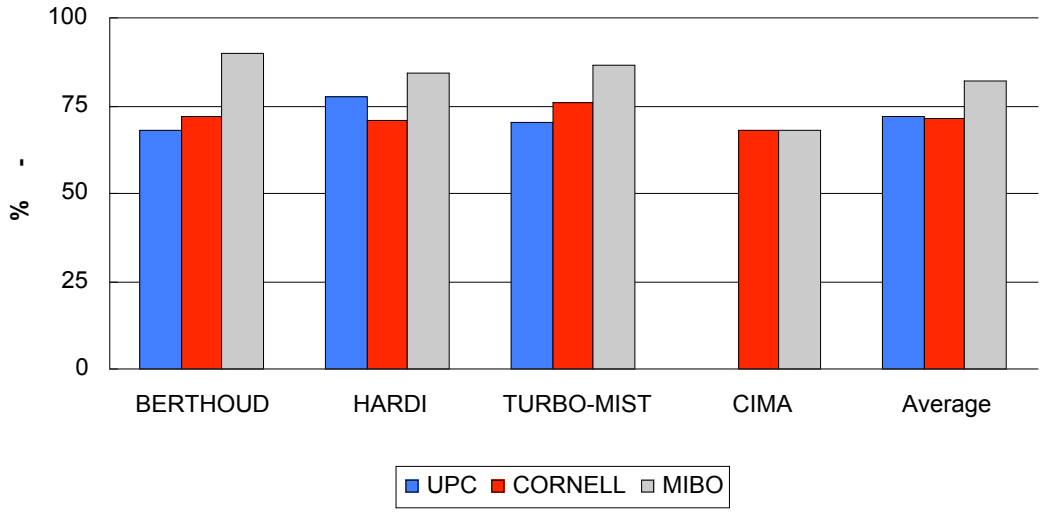


Figure 4 Symmetry of four sprayers as evaluated by 3 patternators

Vertical pattern

All three patternators were tested and the vertical patterns compared. One example is shown for illustrative purposes in this report. The left-hand side output from the Hardi sprayer is shown with all 3 patternators in Figures 5-7.

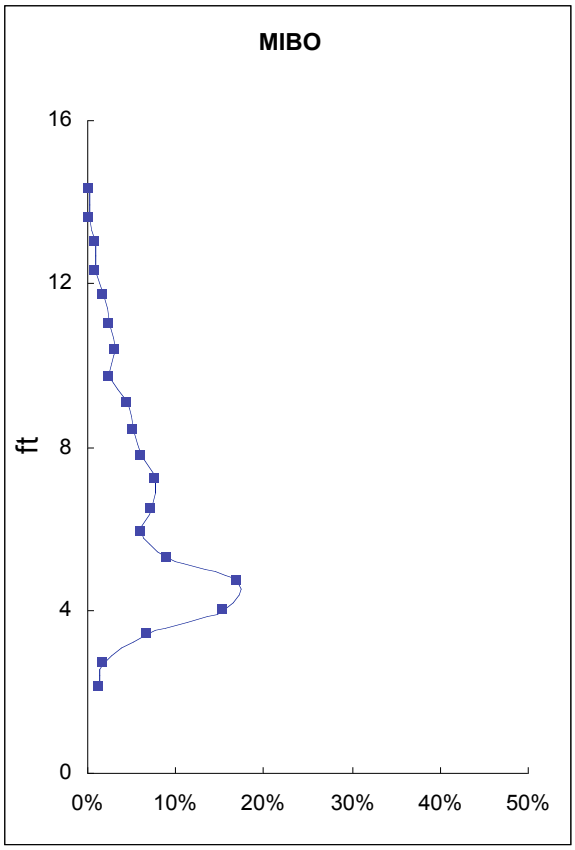


Figure 5 Hardi sprayer, left-side on a MIBO patternator

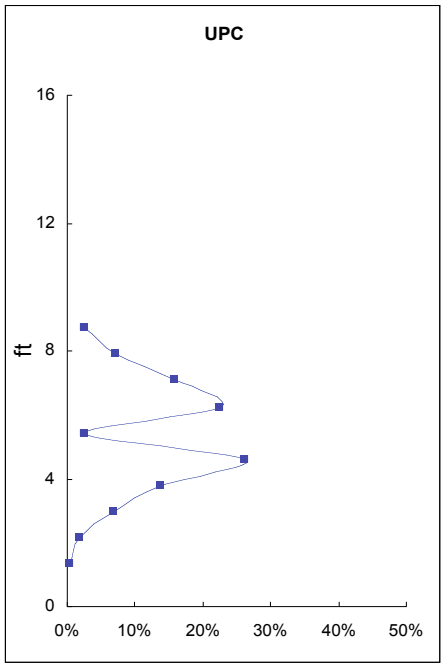


Figure 6 Hardi sprayer, left-side on a UPC patternator

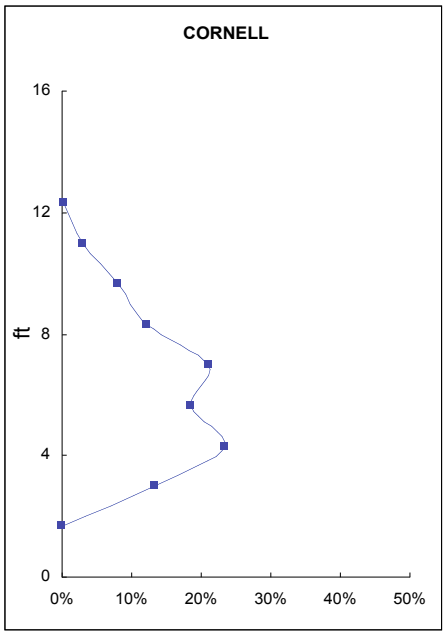


Figure 7 Hardi sprayer, left-side on a Cornell patternator

Note the similarity and location of the three curves with all three patternators.

Demonstrations

We demonstrated the three designs at fruit grower meetings in the Hudson Valley, the Finger Lakes, Lake Erie region and on Long Island and subsequently improved the design. The plans are available for growers and a number have already been built.

The demonstration progam showed how a simple patternator can be used to adjust the nozzles and the resulting spray cloud emitting from their sprayer. Good targeting should give better pest and disease control and lead to less drift. The growers provided excellent comments for the final design of the patternators. The patternators will also be shown at winter conferences and in the spring/summer 2007 will be shown to the Lake Ontario region fruit growers.

Attaining expected outcomes

The demonstration progam influenced at least 400 growers, the approximate number who attended the demonstrations. A number of growers used the simple plans to construct their own patternators thus reducing pesticide drift considerably.

I worked closely with Cornell Cooperators:
IPM Fruit educators: Tim Weigle: demo at North East, PA
Hudson Valley fruit & Veg. program:Teresa Rusinek and Mike Fargione: demo at Marlboro, NY
Finger Lakes grape team: Tim Martinson: demo at Himrod/Watkins Glen
Lake Erie grape team: Andy Muza demo at North East, PA
Long Island team: Rebecca Wiseman, Sustainable Ag Program, demos at Riverhead and Mattituck

Conclusions

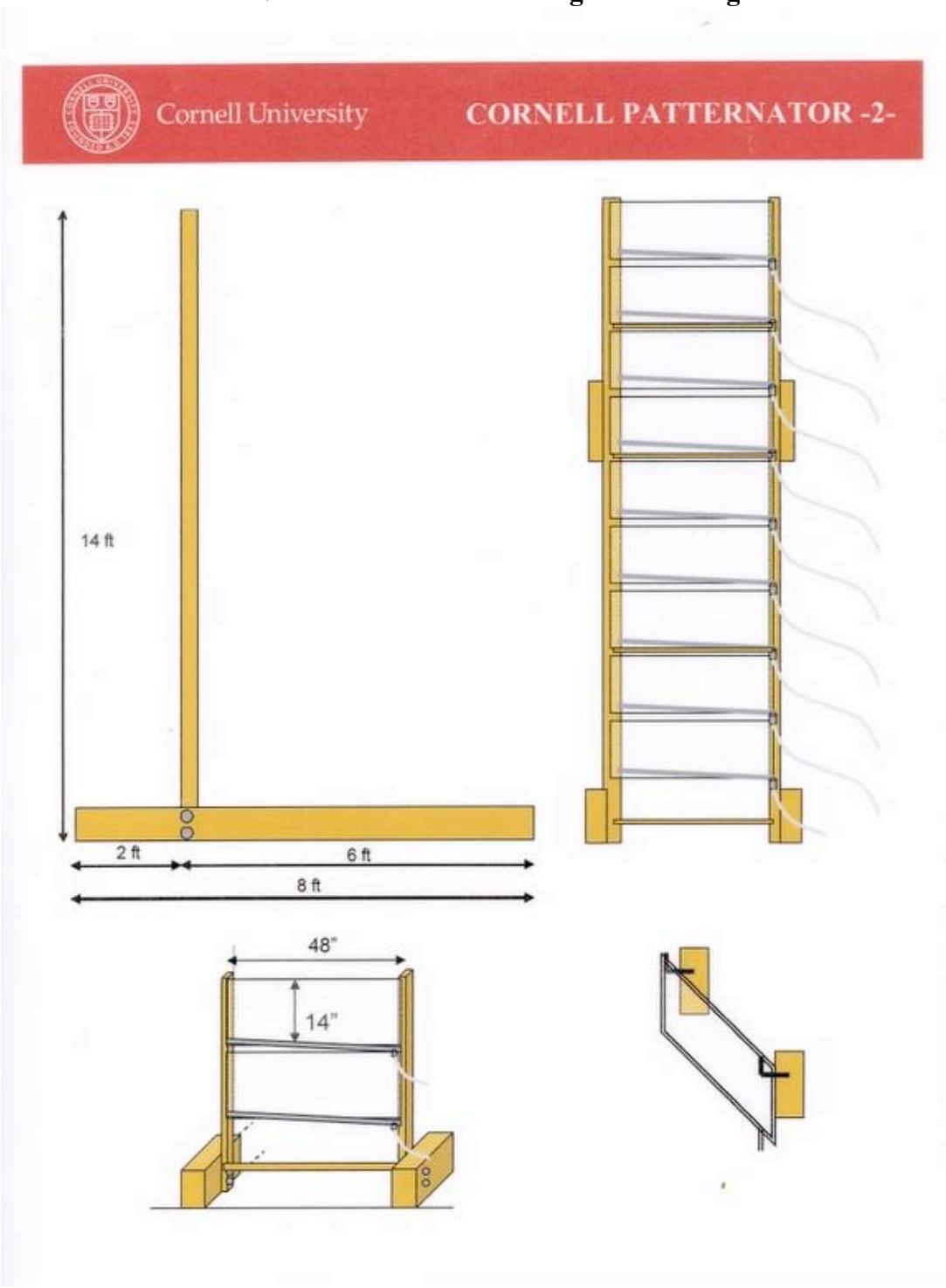
The tests show that the Cornell and the UPC version of patternator are very similar to the results obtained with the MIBO. Using the simple plans, growers will be able to build their own patternator and adjust their sprayers for specific blocks on their farms. They will be able to reduce pesticide drift considerably (up to 90%) via better targeting, they will apply pesticides more effectively leading to better control of insects/diseases as more spray is hitting the target and they may be able to reduce their pesticide use by up to 20%. Fine tuning the sprayer will give the operators a better understanding of their machines.

Acknowledgements

I wish to acknowledge the technical assistance from Professor Emilio Gil, Bruce Wadhams and Nate Robbins.

I wish to thank NY IPM and ARDP for their financial support.

APPENDIX A Handout for the growers-Design and build list



PRICE LIST

No.	Item	Units	Price/ud. ($)	Total price ($)
1	Graduated cylinders	10	7.00	70.00
2	Hosebarb	10	0.28	2.80
3	2 x 4 x 10 wood boards	2	12.60	25.20
4	2x4x10 & 2x8x8 wood boards			21.08
5	Plastic gutter		5.48	62.28
6	Screen material	9	3.84	34.56
7	Screens built	9	20.70	186.30
8	Hooks	9	0.27	2.43
9	Bolts & washers			21.04
10	Copper drains	9	0.37	3.33
11	Hooks & fasteners	9	0.75	6.75
12	Wood & glue			28.72
13	Hose barbs	9	0.31	2.79
14	Plastic hose			22.00
	Total			**489.28**

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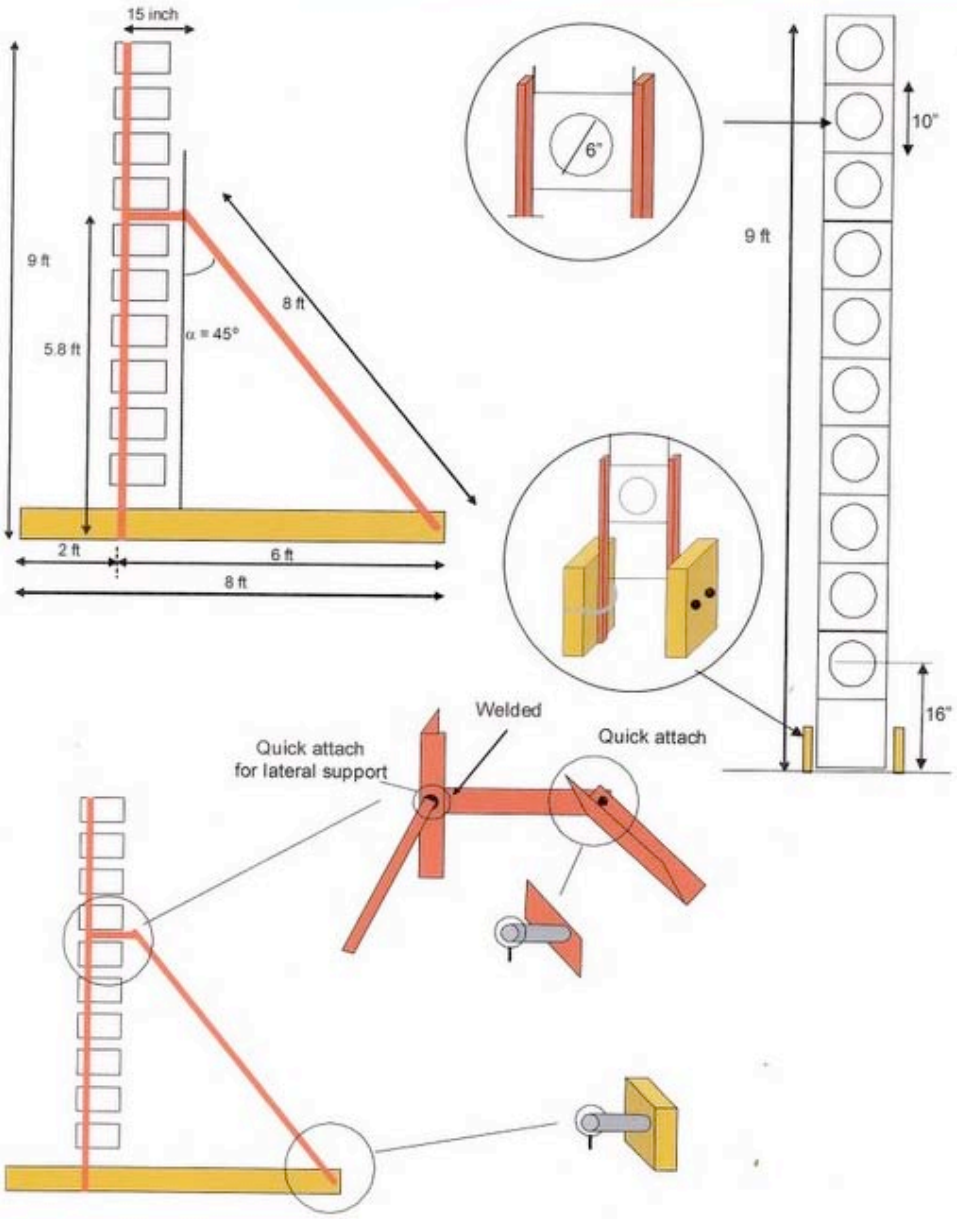
CORNELL PATTERNATOR -1-



Cornell University

CORNELL PATTERNATOR -1-

PRICE LIST

No.	Item	Units	Price/ud. ($)	Total price ($)
1	Graduated cylinders	10	7.00	70.00
2	Hosebarb	10	0.28	2.80
3	1 1/2 x 1 1/2 x1/8 angle iron (ft)	37	1.64	60.68
4	1/8"x 2" x 6' angle iron steel	1	41.96	41.96
5	1/8" steel agle	2	5.48	10.96
6	Funnels (7" diameter)	10	6.19	61.90
7	Plastic frames (10" x 10")	11	12.95	142.45
8	PVC elbows (6" diameter)	10	17.76	177.60
9	5. Bolts & paint			68.20
10	Nuts & bolts & washers			11.48
11	Air conditioner foam			34.43
12	Rivets			2.50
13	Silicone			5.19
14	2' x 8' wood boards & bolts			33.58
15	Plastic hose			22.00
16	Paint and primer			17.16
17	Wood box & glue			57.44
	Total			**820.33**